SYSTEM FOR CONTROLLING AN ELECTRICAL DEVICE

BACKGROUND OF THE INVENTION

The present application relates to a system for controlling an electrical device.

Referring to FIG. 1, an electrical system 10 includes a control panel 20 that utilizes a digital computer (or otherwise) to provide effective control of many associated electrical devices. The centralized control panel 20 determines the effects on the entire system 10, or a portion of the system 10, for enabling or disabling an electrical device 24. For example, such associated electrical devices may include motors, pumps, generators, fans, valves, generators, switches, lights, etc. One type of control panel 20 is generally known as a programmable logic controller, such as those sold by Allen Bradley. The control panel 20 typically provides a low voltage, such as 0-24 volts (approximately), to a pilot relay 32. The pilot relay 32 is attached to the exterior of the a contactor housing 26, normally within a pilot relay housing 30, which is typically further located within a motor control center. The pilot relay 32 is electrically interconnected to a contactor 22 which switches on (e.g., starts or otherwise energizes) and off (e.g., stops or otherwise de-energizes) a remotely located associated electrical device 24, such as a motor. The interconnection of the pilot relay 32 to the contactor 22 is typically by a high voltage (or current) connection, such as for example, 120 volts (or approximately). The contactor 22 may alternatively be any type of control device, such as for example, a relay, switch, or

starter. The contactor 22 is electrically connected to the electrical device 24 by three power cables 28a, 28b, and 28c for a three-phase electrical device. One, two, or three power cables are used for different types of devices.

The system shown in FIG. 1 is the traditional system for interconnecting a pilot relay to a contactor and has several disadvantages. Initially, an opening is drilled or otherwise opened in the side of the contactor housing 26 and the pilot relay housing 30 is typically threaded onto the contactor housing. The 120 volt wires controlling the contactor 22 are "fished" through the opening in the side of the contactor housing 26 and interconnected to the pilot relay 32 within the pilot relay housing 30, which is difficult and time consuming if the available space is limited. The pilot relay housing 30 is secured, typically with a nut, to the contactor housing 26. The wire(s) from the digital control panel 20 are likewise connected to the pilot relay 32 for controlling the pilot relay 32.

The size of the pilot relay and accordingly the pilot relay housing tends to be rather large because of the relatively large size of the relay necessary to switch 120 volts to the contactor for control. Unfortunately, the relatively large size of the pilot relay housing requires space that may not be readily available, especially in a crowded motor control center. Over an extended time period because of the mechanical nature of a relay, especially in unclean environments, the pilot relay have a tendency to fail or otherwise make unreliable connections. For example, the contacts of the relay may corrode or otherwise the relay may provide surges in current which are unacceptable for reliable operation of the electrical device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a digital control panel, a pilot relay, and a contactor housing with a contactor therein for controlling a motor.

FIG. 2 illustrates a transmitter and receiver combination for a contactor housing.

FIG. 3 illustrates a transmitter and multiple receiver combination for a contactor housing.

FIG. 4 illustrates a transmitter and receiver combination for multiple contactors within a contactor housing.

FIG. 5 illustrates a transmitter and spaced apart receiver for a contactor housing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present inventors considered the aforementioned system and considered the national electrical codes which prohibit interconnecting low voltage lines, such as the 24 volt line from the digital control panel 20, into the contactor housing 26 where high voltage lines are present. The electrical voltage and/or current is typically greater within the contactor housing 26 than the corresponding electrical voltage and/or current provided by the digital control panel. With this limitation imposed by the national electrical codes, the present inventors determined that replacing the single device interconnection, namely the pilot relay 32 within the pilot relay housing 30, with a two-part interconnection permits

a more effective interconnection to be developed. The initial consideration would consider a two-part interconnection to be less effective and useful than a one-part interconnection, which is counterintuitive, at least in part.

Referring to FIG. 2, the digital control panel 20 provides a low voltage signal, such as 24 volts, to a transmitter 50. The transmitter 50 is preferably supported by the controller enclosure 26 and is preferably aligned with an opening 52 therein. The transmitter 50 receives the low voltage and/or low current input from the digital control panel 20, and in response thereto, selectively provides an optical signal through the opening 52 of the controller enclosure 26. In this manner, it may be observed that the low voltage electrical signals are free from being routed within the controller enclosure 26 in violation of the national electrical codes, but while permitting a signal to pass into the controller enclosure 26 in response thereto. Moreover, it may be observed that using an optical transmitter, such as a light emitting diode, is free from including a relay or other mechanical switching mechanism. Further, the electronics necessary to convert a low voltage and/or low current signal to an optical signal is minimal so the space required for the transmitter 50 including the housing for the transmitter is negligible. Also, the transmitter 50 may be relatively inexpensive compared to a suitable pilot relay 32. In addition, the power consumption of the optical transmitting device is small and the electrical isolation is greatly increased which increases the safety of the system.

A receiver 60 receives the optical signal from the transmitter 50. The receiver 60 may include any suitable optical receiving device, such as a photo-transistor. The receiver is preferably supported by the controller enclosure 26 and is preferably

aligned with the opening 52 therein. The receiver 60 is interconnected to the 120 volt line controlling the contactor 22 by a switching device, such as a solid state alternating current line switch. Accordingly, in response to receiving the optical signal the receiver 60 may selectively activate and de-activate the contactor 22. Similarly, the receiver 60 may be designed in such a manner to be free from a relay or other mechanical switching mechanism. Further, the electronics necessary to receive an optical signal and switch a solid state switch is minimal so the space required for the receiver 60 including the housing for the receiver is negligible. Also, the receiver may be relatively inexpensive compared to a suitable pilot relay 32. In addition, the power consumption of the optical receiving device is small and the electrical isolation is greatly increased which increases the safety of the system.

After further consideration of the interconnection between the transmitter 50 and the receiver 60, they are preferably interconnected in such a manner as to prevent substantially all light sources, other than the transmitter 32, from reaching the receiver. For example, the transmitter 50 and the receiver 60 may be tubular members that are threaded together to form a light tight seal, while simultaneously providing a mechanism for securing the transmitter 50 and the receiver 60 to the controller enclosure 26. While forming a substantially light sealed interconnection is advantageous, preferably the transmitter 50 includes a non-visible optical source (i.e. to the human visual system), such as an infra-red diode, and the receiver includes a corresponding non-visible optical receiver, such as an infra-red receiver. In this manner, the system is more tolerant to inadvertent light sources that may reach the detector of the receiver 60.

In one embodiment the transmitter and the receiver preferably only indicate whether or not the corresponding electrical device is to be energized or de-energized. Referring to FIG. 3, the optical signal may be modulated, a carrier signal, different frequencies, pulsed, or otherwise to provide additional information to one or more receivers. Accordingly, a single transmitter 50 may provide information to multiple receivers 70a, 70b, and 70c with the appropriate receiver switching (e.g., on or off) its respective contactor 72a, 72b, and 72c. Referring to FIG. 4, the optical signal may include information provided to a single receiver 80 that indicates which, of a plurality of contactors 82a, 82b should be energized or de-energized. It may likewise be observed that the transmitter is electrically connected to the controller 20, while the receiver is electrically connected to the contactor(s), and are accordingly separately wired which results in simpler and more efficient installation.

Referring to FIG. 5, another embodiment includes the receiver 90 being location at a location remote from the transmitter 50. The optical signal then passes through the enclosure 26 to the receiver 90. This permits easier placement of the receiver 90 within the enclosure 26. The receiver 90 preferably includes a metal tab or other electrical interconnection which permits connection of the receiver 90 directly to the contactor. In this manner the interconnection is free from any additional wiring which saves supplies and results in quicker installation.

It is to be understood that additional electrical elements may be provided within the electrical paths, such as for example, protection devices, starters, relays, etc. Also, the optical interconnection between the transmitter and the receiver may be arranged

in such a manner that the optical signal only passes through a portion of the wall of the enclosure, such as for example, the optical transmitter and/or receiver being partially within the wall of the enclosure. In addition, the optical interconnection between the transmitter and the receiver may be arranged in such a manner that the optical signal interconnection is provided on the exterior of the enclosure or within the enclosure. In such an exterior interconnection or interior interconnection, preferably the low voltage conductors (e.g., less than approximately 45 volts, and preferably less than approximately 35 volts) are not routed from the exterior to the interior of the enclosure. Preferably, the transmitter and the receiver are proximate and/or supported by the enclosure.

Typically, the receiver includes a neutral conductor, a line conductor (e.g., the 120 volt conductor), and a load conductor (e.g., the conductor to the contactor). The preferred embodiment of the receiver only includes a line conductor and a load conductor, and hence is free from including a neutral conductor.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.